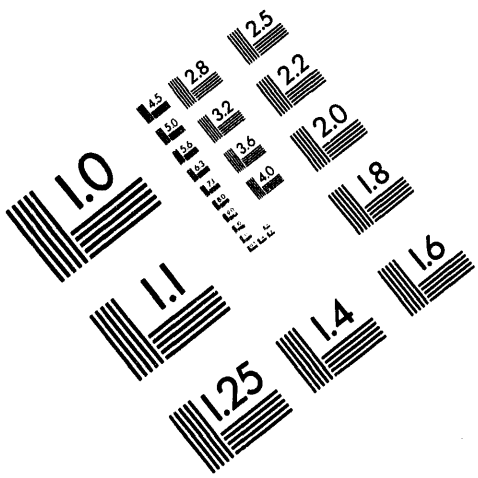

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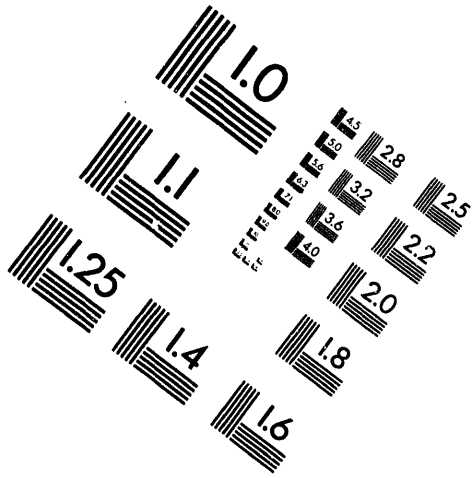

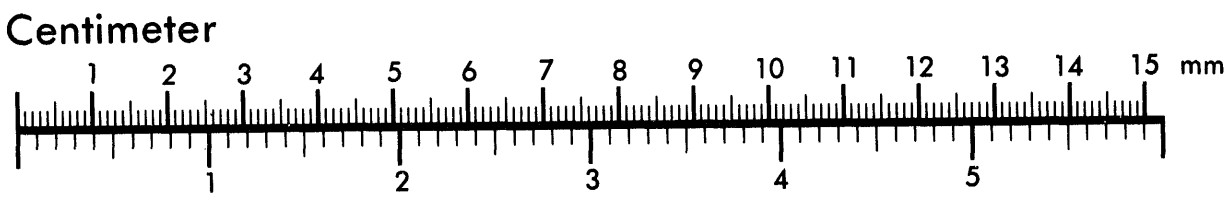

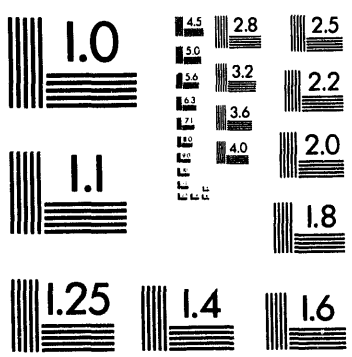

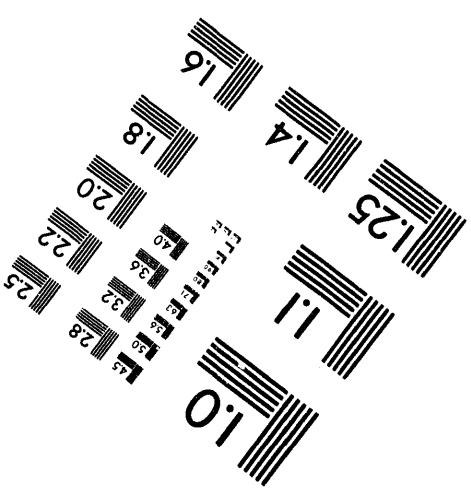

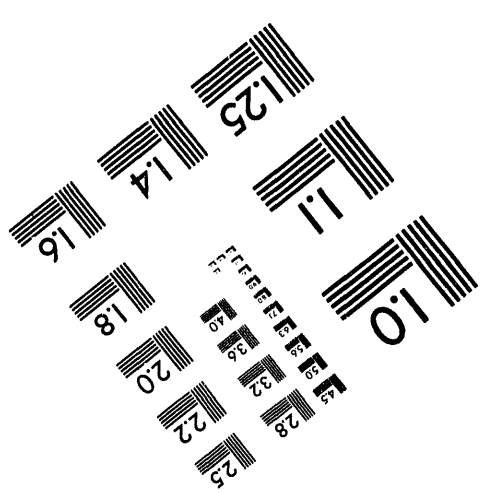

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YEARLY TECHNICAL PROGRESS REPORT
~~Summary Annual Report~~ 11.7. 6/29/94

STATE AND NATIONAL ENERGY AND ENVIRONMENTAL RISK ANALYSIS SYSTEMS FOR UNDERGROUND INJECTION CONTROL

Contract Number:	DE-AC22-92MT92004
Contractor:	ICF Resources Incorporated
Date:	April 1994
Contract Date:	April 7, 1992
Anticipated Completion Date:	August 31, 1994
Government Award:	$194,792
Program Manager:	Michael L. Godec
Principal Investigator:	Glenda E. Smith
Technical Project Officer:	Brent W. Smith U.S. Department of Energy Metairie Site Office
Reporting Period:	April 1993 - April 1994

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Table of Contents

Executive Summary

ICF Resources' project, entitled "State and National Energy and Environmental Risk Analysis Systems for Underground Injection Control" originally included two primary tasks (development of state and national systems respectively) and a technology transfer element. The state system was planned to assist states with data management related to underground injection control (UIC). However, during the current period, a change was received to the Statement of Work which discontinued work on this task. Prior to discontinuation, the concept for a protocol that would assess the relative risk of groundwater contamination due to UIC activities in various areas of a state was developed. A risk assessment protocol similar to that designed could be used to assist states in allocating scarce resources and potentially could form the analytical basis of a state variance program.

The national energy and environmental risk analysis system (EERAS) is designed to enhance DOE's analytical capabilities. This concept will be demonstrated using UIC data. The initial system design for EERAS has been completed but may be revised based on input from DOE and on the pending UIC regulatory changes. Data has been collected and organized and can be input once the file structure is finalized. The further development options for EERAS defined as part of this project will allow for the full development of the system beyond the current prototype phase, which will enhance DOE's analytical capabilities for responding to regulatory initiatives and for evaluating the benefits of risk-based regulatory approaches.

Introduction

This project was designed to develop prototypes for two distinct analytical systems, one at the state level and one at the national level, that focus on data management for underground injection control. During this second year of the project, the work on the state system was discontinued. Software was selected for the national system and initial data entry has been completed. These systems are described in greater detail in the Project Description section below.

Project Description

As outlined in the current contract statement of work, this project includes three primary tasks, one of which is abbreviated from its original form, as described below.

Task 1. *Prototype State UIC Risk Management System.* This task encompasses concept development for a protocol that can be used with state information management systems for underground injection control (UIC) data to assess the relative risk of various areas within the state.

Task 1.1. *Identify System Requirements.* The potential pathways for groundwater contamination from underground injection will be characterized. The risk factors affecting each of these potential pathways will be identified, and potential data sources examined. A paper outlining the concept for a risk assessment protocol will be prepared.

Task 1.2. *Data Availability.* The availability and possible sources of information for each of the risk factors identified will be investigated. Possible analogs or rules of thumb that can substitute for required data will be included. To the extent possible, the relative importance of each data item to the relative risk of contamination will be identified. The results of this task will be summarized in a brief report.

Task 2. *Preliminary National EERAS.* This task involves developing a preliminary national energy and environmental risk analysis system (EERAS) based on UIC data. Part of the proposed effort will require developing methods to link EERAS with the existing TORIS and GSAM databases and analytical models.

Task 2.1. *Assess Required Linkages for EERAS with TORIS and GSAM.* Since EERAS is intended to provide the environmental data to be used in analyses performed using both the Tertiary Oil Recovery Information System (TORIS) and the Gas Systems Analysis Model (GSAM), this task will identify the structural elements and linkages required to allow a single database structure to work with both TORIS and GSAM.

Task 2.2. *Identify EERAS Analytical Needs and Initial Structure.* In consultation with DOE, identify EERAS analytical needs to expand DOE's capabilities for responding to environmental regulatory and policy initiatives. Based on these needs, design the initial structure for the EERAS database. A flexible database structure for managing environmental data at the reservoir-level, field-level, county-level, and basin-level will be designed and developed. Environmental parameters in the database may include the subsurface setting or surface location (such as an area with high corrosion potential or a wetland area), data on environmental risks, costs of environmental compliance, etc. The database structure and linking methodology will be developed

in consultation with DOE personnel, to assure that the framework meets DOE's requirements, is flexible enough to accommodate future enhancements beyond primarily UIC issues, and is compatible with existing DOE analytical systems. A deliverable summarizing the analytical needs and initial EERAS structure will be prepared.

Task 2.3. *Assess UIC Data Sources and Availability.* The key data for development of a system to analyze risks of USDW contamination from underground injection at the national level will be identified. Information needs to develop a comprehensive UIC risk analysis system will be identified, ranked, and documented, in consultation with DOE.

Task 2.4. *Input UIC-Related Environmental Data to EERAS.* This subtask involves collecting and inputting UIC-related environmental data to the EERAS structure from Task 2.2 based on the priorities established in Task 2.3. Complete, detailed reservoir-level coverage for the nation is not possible within the time and scope of this effort. However, some of the data that may be added to EERAS within the scope of this subtask include (sources of these data are shown in parenthesis):

- Estimated depth of deepest USDW (Gruy, 1989).
- Corrosivity probability data (Michie, 1988).
- Number of injection wells (Gruy, 1989).
- Number of abandoned wells (Gruy, 1989).
- Depth of surface casing (Gruy, 1989).
- Depth of perforation (Gruy, 1989).
- Average depth of injection zone (Gruy, 1989).
- Average depth of producing zone (Gruy, 1989).
- Estimate of abandoned wells per acre and within typical AOR (Gruy, 1989).
- Percent of injectors with short surface casing (Gruy, 1989).
- Produced water volumes by county (Michie, 1988).

Upon completion of this task, a copy of the database will be provided to DOE.

Task 2.5. *Develop National Risk Assessment Methodology.* Using the available data in EERAS, develop an analytical methodology to identify the relative risk of groundwater contamination due to UIC by area of the nation (perhaps at the basin level). The methodology will draw on reservoir-, field-, county-, and basin-level information, using the most disaggregate data currently available in EERAS for each parameter in risk estimation calculations.

Task 2.6. *Perform Risk Assessment for UIC.* An assessment of the nationwide potential for USDW contamination from underground injection, including current and future oil resources affected, will be performed using the methodology developed in Task 2.5 and TORIS. [It will not be possible to include an assessment of gas resources because GSAM will not yet be fully functional.] The proposed work will identify and document areas, if any, with large future enhanced recovery potential that have moderate to high risk of USDW contamination from underground injection. These areas may merit further analysis or information collection by DOE, EPA, and the states. This risk assessment will also serve as a test of the proposed methodology, which will be revised as appropriate to reflect any improvements or limitations discovered during performance of the assessment.

Task 2.7. *Evaluate Further EERAS Development Options.* This subtask involves identification of the data requirements and analytical tools required for a more detailed assessment of nationwide UIC contamination potential to meet the needs outlined in Task 2.2. Possible areas for future research will also be identified to expand EERAS beyond UIC issues to incorporate other environmental concerns. Analytical methods that could be developed using EERAS, TORIS and GSAM to determine energy and environmental impacts of proposed policies, regulatory initiatives, or compliance strategies will also be documented.

Task 3. *Technology Transfer.* Technology transfer efforts will focus on providing information to state regulators and to industry about the analytical capabilities being developed as part of this project. This may include attendance at meetings of the Ground Water Protection Council, the Interstate Oil and Gas Compact Commission, or similar forums where state and industry concerns regarding groundwater contamination from UIC activities are discussed.

Task 3.1. *Prepare Papers Summarizing Results.* Paper(s) summarizing the results of the proposed work will be prepared for submission to professional journals and symposia. DOE will be given the opportunity to review and participate in the preparation of these papers.

Task 3.2. *Prepare EERAS Documentation.* The current status, database structure, analytical methodologies, and operation of EERAS will be documented and transferred to DOE. This documentation will consist of a draft final report and a final report. DOE and others will be provided opportunity to comment on the work throughout the effort, by reviewing these reports, along with the other progress reports required under this effort (discussed below).

Task 3.3. *Meet Reporting Requirements.* All DOE monthly, quarterly, and final reports will be prepared and submitted in a timely fashion. In addition, an interim report on research results and a draft final report for review by experts knowledgeable in UIC issues will be prepared and circulated for comment. The input received from these external reviewers will serve to assist the proposed team in developing a higher-quality final report and products for DOE.

Project Status

Until early Fall 1993, most of the effort of this project was focused on Task 1, which has since been discontinued. These efforts were discontinued to avoid potential overlap with other ongoing efforts and because other factors affected the ability to successfully complete the development of the risk assessment protocol as originally conceived. The work completed is being documented to provide information to other ongoing efforts.

Since the change in the Statement of Work was received, efforts have been focused on development of the national EERAS system. The initial design work previously completed is being reviewed to assure that the structure developed will be compatible with both TORIS and GSAM as these models are developed and improved by DOE. Conceptually, the EERAS system will be designed as shown in Figures 1 and 2. Figure 1 illustrates that a locational translation file will serve as a "gatekeeper" to match reservoir data in TORIS and GSAM with data aggregated at other locational levels (such as county or basin). Figure 2 shows an example of the modular format of the database and examples of the type of information that may be included in each module. The examples in this figure have not been limited to UIC-related data, but are described more broadly to provide an indication of the potential of the system in its full development.

Figure 1. Energy and Environmental Risk Analysis System (EERAS)

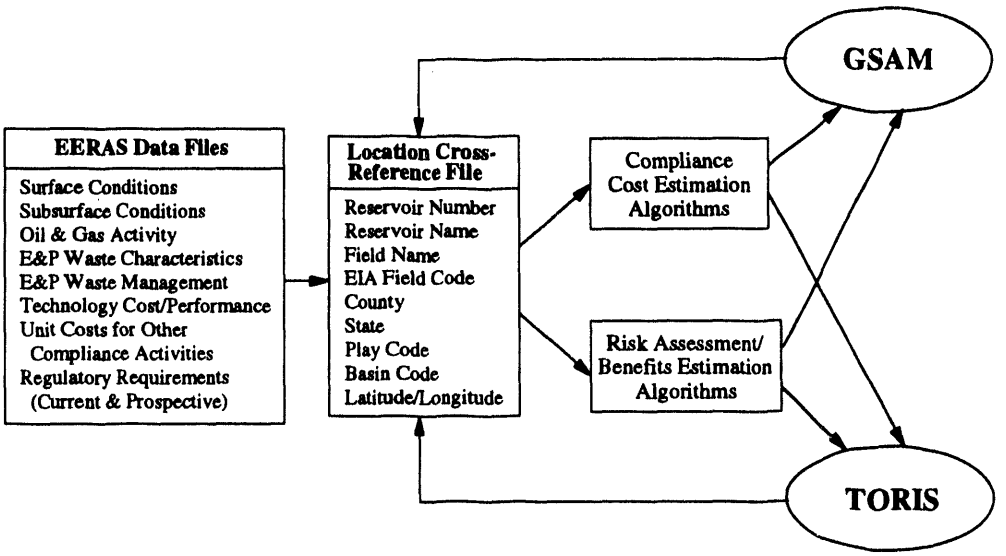

Figure 2. EERAS Data Files and Example Contents

Surface Conditions Files	Subsurface Conditions Files	Oil & Gas Activity Files	E&P Waste Characterization Files
Federal lands Wetlands Endangered species habitat Wilderness lands OCS moratoria areas Non-attainment areas (ozone, other?) Distance to urban areas Distance to surface water Annual rainfall Evaporation rate Surface water quality Water depth (for offshore fields) Background radiation level	Presence of groundwater Groundwater currently used for human consumption Name of primary/secondary aquifer systems Depth to shallowest groundwater Depth of 3000 TDS groundwater General soil type (sand, clay, etc.) Corrosivity indicator Groundwater quality (TDS, salinity, etc.)	Disposal well locations Depth of injection zone Number of injection wells Est. number of abandoned wells Typical depth of surface casing Location of gas processing plants	Produced water volumes/ratio Assoc. waste volumes by type Est. volumes of SO2, NOx, VOCs, etc. NORM level Produced water quality

E&P Waste Management Files	Compliance Cost Files	Technology Cost/ Performance File	Regulatory Requirements File
Methods of produced water disposal (distribution) Methods of associated waste disposal Methods of drilling waste disposal	Pit liner cost Cost to install & operate groundwater monitoring Cost of offsite disposal by method Cost to excavate contaminated soil Bioremediation costs Cost of closed drilling system Costs for barging wates to shore Costs for various aspects of upgrading ASTs Injection well drilling costs MIT costs AOR costs Permit costs Insurance costs	Membrane filtration: Size, weight Installation cost, operating cost Effectiveness Hydrocyclones: Size, weight Installation cost, operating cost Effectiveness Improved Gas Flotation: Retrofit cost, incremental operating Cost Effectiveness NOx controls: Type, effectiveness, cost	Current regulatory requirements Potential regulatory requirements (Format & content of this file dependent on how cost & benefit algorithms developed)

Given the changes to the state of the art in database management systems since this project commenced, a review of available systems was conducted to select the most appropriate platform for the EERAS database development. After careful consideration of the capabilities and features of various commercial software products, it was determined that FoxPro for DOS was the best selection. [GSAM is currently being developed in a DOS environment.] FoxPro also has a Windows version that will enable the database to be converted to that software in the future. In addition, FoxPro is developing a UNIX-based version. [TORIS is currently a mainframe-based UNIX system.]

Status by Task. Task 1.1 is complete; the paper was provided as Attachment A to the 1993 Summary Annual Report. Task 1.2 is complete except for drafting the report, which will be undertaken in the near future.

Task 2.1 is complete, as illustrated by Figure 1. Task 2.2 is also essentially complete, but the deliverable has not yet been finalized. Task 2.3 is complete, and the data has begun to be input to the database structure under Task 2.4. Task 2.5 has proven to be more difficult than anticipated due to the discontinuation of risk assessment work under Task 1. The design will be completed over the next few months so that Task 2.6 can be performed. Some work has also been performed under Task 2.7.

Technology transfer efforts under Task 3 have been facilitated through attendance at meetings of the Ground Water Protection Council and similar forums. So far, one paper has been completed under Task 3.1; as additional work under Task 2 is completed, additional papers may be prepared. Task 3.2 cannot be completed until the EERAS design is finalized under Task 2.

Planned Activities

Completion of the project is anticipated by August 31, 1994. Much of the effort will focus on finalizing the structure for the national EERAS, inputting the rest of data that has been collected, and completing the deliverables to document EERAS and illustrate its future potential. A methodology for performing national risk assessments will be devised and a preliminary assessment completed.

Summary

The EERAS being developed as part of this project will enhance DOE's analytical capabilities for responding to pending federal UIC regulatory changes. The potential future development of this system will continue to enhance DOE capabilities for analyzing risk-based regulatory approaches.

Report Distribution List

Document Control Center
United States Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940, MS 921-118
Pittsburgh, PA 15227-0940

References

None

Publications

"Class II Risk Assessment Protocol," presented at the Symposium on Class II Injection Well Management, November 1992.

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10/5/94
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